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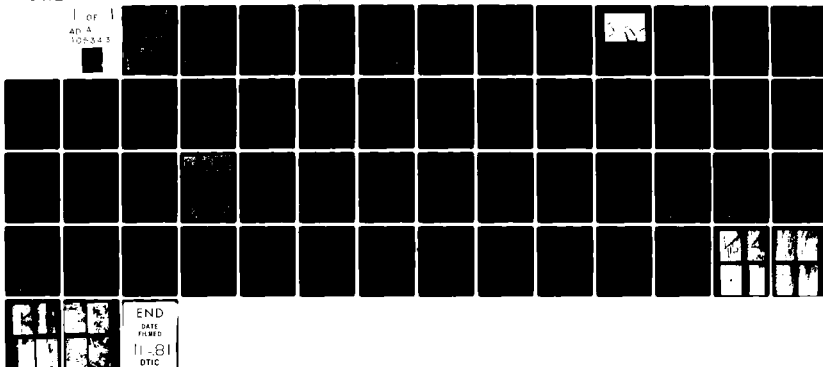
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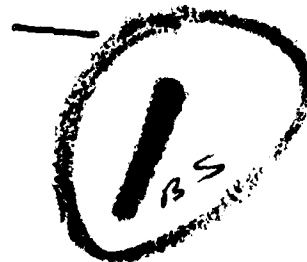
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**LEVEL II**



**WHITE RIVER BASIN**

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**WALLACE LAKE DAM  
CARTER COUNTY, MISSOURI  
MO 31263**

**PHASE 1 INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM**



**United States Army  
Corps of Engineers**  
... Serving the Army  
... Serving the Nation

**St. Louis District**

**PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS  
FOR: STATE OF MISSOURI**

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**AUGUST, 1980**

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

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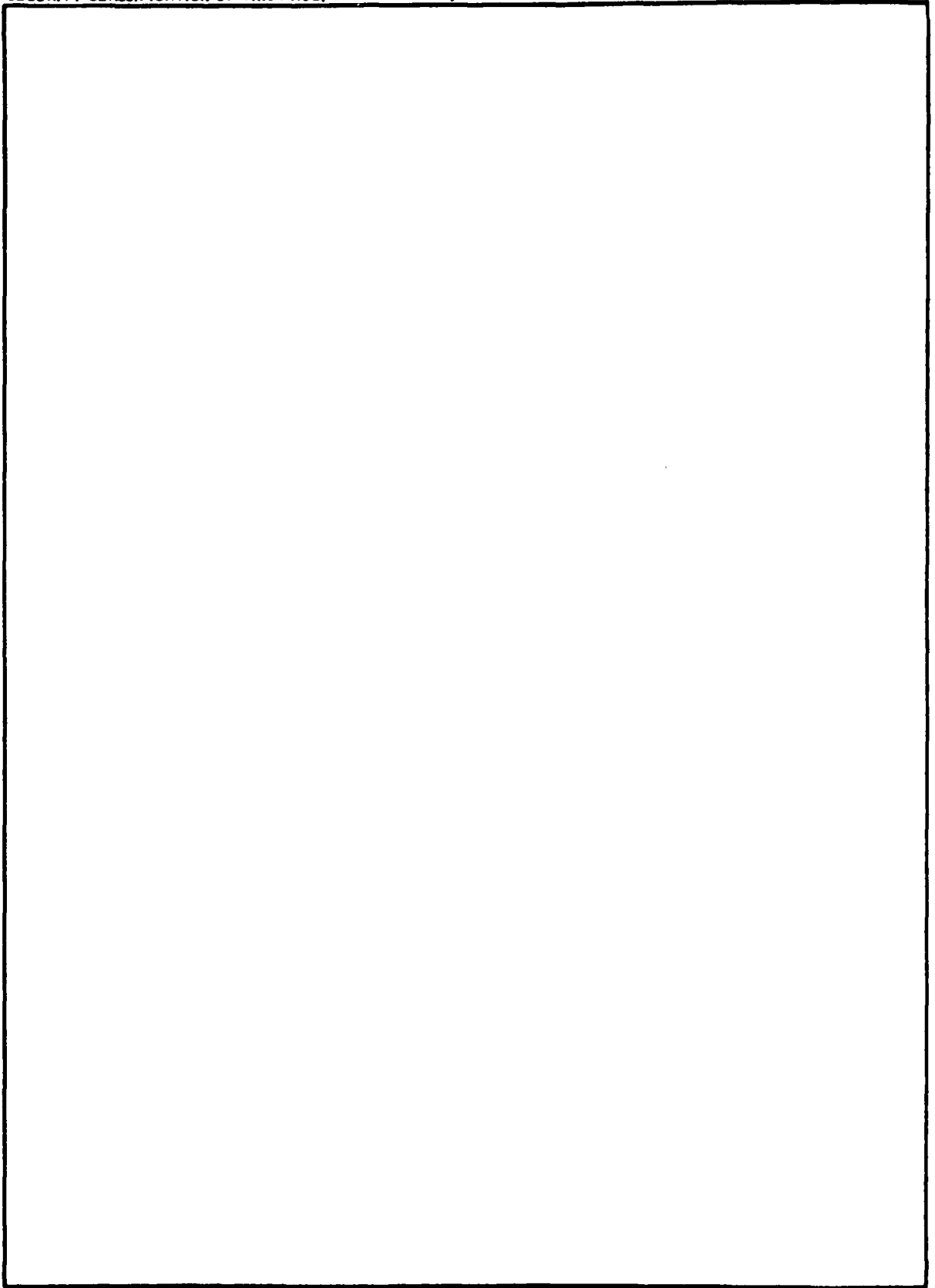
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DEPARTMENT OF THE ARMY  
ST. LOUIS DISTRICT, CORPS OF ENGINEERS  
210 TUCKER BOULEVARD, NORTH  
ST. LOUIS, MISSOURI 63101

REPLY TO  
ATTENTION OF

SUBJECT: Wallace Lake Dam  
Carter County, Missouri  
Missouri Inventory No. 31263

This report presents the results of field inspection and evaluation of the Wallace Lake Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

- a. Spillway will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.
- b. Overtopping of the dam could result in failure of the dam.
- c. Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY:

**SIGNED**

Chief, Engineering Division

**30 OCT 1980**

Date

APPROVED BY:

**SIGNED**

Colonel, CE, District Engineer

**30 OCT 1980**

Date

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WHITE RIVER BASIN

WALLACE LAKE DAM  
CARTER COUNTY, MISSOURI  
MISSOURI INVENTORY NO. 31263

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

Prepared By

Anderson Engineering, Inc., Springfield, Missouri  
Hanson Engineers, Inc., Springfield, Illinois

Under Direction Of

St. Louis District, Corps of Engineers

For

Governor of Missouri

AUGUST, 1980

PHASE I REPORT  
NATIONAL DAM SAFETY PROGRAM  
SUMMARY

Name of Dam: Wallace Lake Dam  
State Located: Missouri  
County Located: Carter  
Stream: Tributary of Cane Creek  
Date of Inspection: July 18, 1980

Wallace Lake Dam was inspected by an interdisciplinary team of engineers from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The purpose of this inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and they have been developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, the St. Louis District, Corps of Engineers has determined that this dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur if the dam fails. The estimated damage zone extends approximately three miles downstream of the dam. Located within this zone are several dwellings, all within the town of Ellsinore.

The dam is in the small size classification, since it is less than 40 ft high, and the maximum storage capacity is greater than 50 ac-ft but less than 1,000 ac-ft.

Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillway will pass 37 percent of the Probable Maximum Flood without overtopping. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The guidelines require that a dam of small size with a high downstream hazard potential pass 50 to 100 percent of the PMF. Considering the height of dam (25 feet) and the maximum storage capacity (63 acre-feet),

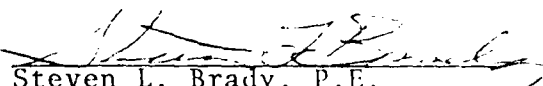


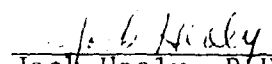
50 percent of the PMF has been determined to be the appropriate spillway design flood. The 100-year flood (1 percent probability flood) will not overtop the dam. The 1 percent probability flood is one that has a 1 percent chance of being exceeded in any given year.

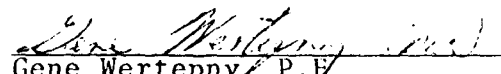
The embankment appears to be in good condition. Deficiencies visually observed by the inspection team were: (1) small trees and brush on the embankment; (2) erosion on downstream slopes; (3) lack of wave protection for the upstream slope; (4) seepage through the pipe valve; (5) non-erodible spillway section; and (6) lack of adequate spillway-embankment separation.

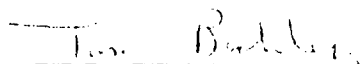
Another deficiency was the lack of seepage and stability analysis records.

It is recommended that the owners take the necessary action without undue delay to correct the deficiencies reported herein. A detailed discussion of these deficiencies is included in the following report.

  
Steven L. Brady, P.E.  
Anderson Engineering, Inc.

  
Jack Healy, P.E.  
Hanson Engineers, Inc.

  
Gene Wertepny, P.E.  
Hanson Engineers, Inc.

  
Tom Beckley, P.E.  
Anderson Engineering, Inc.



AERIAL VIEW OF LAKE AND DAM

PHASE 1 INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
WALLACE LAKE DAM  
MISSOURI INVENTORY NO. 31263

TABLE OF CONTENTS

<u>Paragraph No.</u>	<u>Title</u>	<u>Page No.</u>
	SECTION 1 - PROJECT INFORMATION	
1.1	General	1
1.2	Description of the Project	1
1.3	Pertinent Data	5
	SECTION 2 - ENGINEERING DATA	
2.1	Design	7
2.2	Construction	8
2.3	Operation	8
2.4	Evaluation	8
	SECTION 3 - VISUAL INSPECTION	
3.1	Findings	9
3.2	Evaluation	10
	SECTION 4 - OPERATIONAL PROCEDURES	
4.1	Procedures	11
4.2	Maintenance of Dam	11
4.3	Maintenance of Operating Facilities	11
4.4	Description of Any Warning System in Effect	11
4.5	Evaluation	11
	SECTION 5 - HYDRAULIC/HYDROLOGIC	
5.1	Evaluation of Features	12
	SECTION 6 - STRUCTURAL STABILITY	
6.1	Evaluation of Structural Stability	14
	SECTION 7 - ASSESSMENT/REMEDIAL MEASURES	
7.1	Dam Assessment	15
7.2	Remedial Measures	16

## APPENDICES

### Sheet

#### APPENDIX A

Location Map	1
Vicinity Map	2
Plan, Profile and Section of Dam	3
Profile and Section of Spillway	3A
Plan Sketch of Dam	4

#### APPENDIX B

Geologic Regions of Missouri	1
Thickness of Loessial Deposits	2

#### APPENDIX C

Overtopping Analysis - PMF	1 - 9
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#### APPENDIX D

Photographs Index	1
List of Photographs	2
Photographs	3

## SECTION 1 - PROJECT INFORMATION

### 1.1 GENERAL:

#### A. Authority:

The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection be made of Wallace Lake Dam in Carter County, Missouri.

#### B. Purpose of Inspection:

The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and a visual inspection in order to determine if the dam poses hazards to human life or property.

#### C. Evaluation Criteria:

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, "Recommended Guidelines for Safety Inspection of Dams, Appendix D." These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

### 1.2 DESCRIPTION OF PROJECT:

#### A. Description of Dam and Appurtenances:

Wallace Lake Dam is an earth fill structure approximately 25 ft high and 650 ft long at the crest. The appurtenant works consist of an eight inch diameter drawdown pipe and an earth cut spillway.

Sheet 3 of Appendix A shows a plan, profile, and typical section of the embankments.

B. Location:

The dam is located in the east central part of Carter County, Missouri on a tributary of Cane Creek. The dam and lake are within the Hunter, Missouri 7.5 minute quadrangle sheet (Section 05, T26N, R03E - latitude 36°56.0'; longitude 90°45.6'). Sheet 2 of Appendix A shows the general vicinity.

C. Size Classification:

With an embankment height of 25 ft and a maximum storage capacity of approximately 63 acre-ft, the dam is in the small size category.

D. Hazard Classification:

The St. Louis District, Corps of Engineers has classified this dam as a high hazard dam. The estimated damage zone extends approximately three miles downstream of the dam. Located within this zone are several dwellings, all within the town of Ellsinore. The downstream hazard zone through the town of Ellsinore was verified by the inspection team.

E. Ownership:

The dam is owned by Mr. Edwin Wallace. The owner's address is Box 113, Ellsinore, Missouri (telephone number 314/322-5379).

F. Purpose of Dam:

The dam was constructed primarily for use as a fish hatchery.

G. Design and Construction History:

No design plans were available for this dam. Information supplied by the owner indicated that the dam was designed by the Soil Conservation Service. Upon contacting the SCS, no plans for this dam could be found. However, the field personnel recalled that design data were furnished for this dam. Information received indicated that the design height of dam was 15 feet, and the appurtenant works were to consist of a draw-down pipe and an earth cut spillway.

Mr. Wallace stated that field representatives of the Soil Conservation Service surveyed the site and set stakes at each end of the dam to assist with the vertical and horizontal control of the construction.

During the construction of the dam in 1976, Mr. Wallace stated that the embankment was built from each end towards the center. The last section constructed was the section near the

center of the dam. After closure of the "V" section in the center, Mr. Wallace observed that the height of the dam was above the roadway surface of an upstream county road (approximately 500 feet upstream of the closest point of the dam). The height of the dam was lowered (amount unknown), with the excess material removed placed on the upstream and downstream slopes of the dam. This resulted in reducing the planned side slopes of the embankment.

Mr. Wallace indicated that the lake level is normally maintained about 2 feet below the spillway elevation. The lake level is lowered an additional 4 feet in the fall to control weed growth around the reservoir. The lake is drawn down by use of the 8 inch drawdown pipe. The water removed is wasted downstream or used to maintain the water level of the downstream fish hatchery ponds.

The four downstream fish hatchery ponds were constructed by Mr. Wallace in 1979.

The center section of the embankment settled within the first year following construction. The owner stated that additional material was placed on the crest to raise the settled area. The material for this construction was obtained from the surrounding hillside.

The material for construction of the dam was obtained from the lake bed. A core trench approximately 12 feet wide and 8 feet deep was excavated, and a good clay material was placed and compacted in the trench.

No additional modifications have been reported.

#### H. Normal Operating Procedures:

Normal flows are passed by the uncontrolled spillway section located at the east abutment. The owner indicated that the dam has never been overtopped. The lake level is normally maintained at about 2 feet below the spillway elevation by the owner, to prevent the loss of fish by flows over the spillway. The control of the lake level is by use of the 8 inch drawdown pipe. The level is lowered by an additional 4 feet in the fall of the year to assist in the control of weed growth. The owner stated that the maximum flow he had observed was about 4 inches above the flow line of the spillway.

#### 1.3 PERTINENT DATA:

Pertinent data about the dam, appurtenant works, and reservoir are presented in the following paragraphs. Sheet 3 of Appendix A presents a plan, profile, and typical section of the embankment.

A. Drainage Area:

The drainage area for this dam, as obtained from the U.S.G.S. quad sheet, is approximately 56 acres.

B. Discharge at Dam Site:

- (1) All discharge at the dam site is through an uncontrolled spillways
- (2) Estimated Total Spillway Capacity at Maximum Pool (Top of Dam - El.784.0): 230 cfs
- (3) Estimated Capacity of Principal Spillway: 230 cfs
- (4) Estimated Experience Maximum Flood at Dam Site: 55 cfs (approximately 10 percent PMF)
- (5) Diversion Tunnel Low Pool Outlet at Pool Elevation: Not Applicable
- (6) Diversion Tunnel Outlet at Pool Elevation: Not Applicable
- (7) Gated Spillway Capacity at Pool Elevation: Not Applicable
- (8) Gated Spillway Capacity at Maximum Pool Elevation: Not Applicable

C. Elevations:

All elevations are consistent with an assumed mean sea level elevation of 784.0 for rock ledge at Station 0 + 00 centerline of dam (estimated from quadrangle map).

- (1) Top of Dam: 784.0 feet, MSL
- (2) Principal Spillway Crest: 782.0 feet, MSL
- (3) Emergency Spillway Crest: Not Applicable
- (4) Principal Outlet Pipe Invert: Not Applicable
- (5) Streambed at Centerline of Dam: 762.0 feet, MSL
- (6) Pool on Date of Inspection: 776.4 feet, MSL
- (7) Apparent High Water Mark: 782.3 feet, MSL
- (8) Maximum Tailwater: Not Applicable
- (9) Upstream Portal Invert Diversion Tunnel: Not Applicable
- (10) Downstream Portal Invert Diversion Tunnel: Not Applicable



D. Reservoir Lengths:

- (1) At Top of Dam: 850 feet
- (2) At Emergency Spillway Crest: Not Applicable
- (3) At Principal Spillway Crest: 800 feet

E. Storage Capacities:

- (1) At Top of Dam: 63 acre-feet
- (2) At Emergency Spillway Crest: Not Applicable
- (3) At Principal Spillway Crest: 47 acre-feet

F. Reservoir Surface Areas:

- (1) At Top of Dam: 9.0 acres
- (2) At Emergency Spillway Crest: Not Applicable
- (3) At Principal Spillway Crest: 7.0 acres

G. Dam:

- (1) Type: Rolled Earth
- (2) Length at Crest: 650 feet
- (3) Height: 25 feet
- (4) Top Width: 10 feet
- (5) Side Slopes: Upstream 1V on 4.6H; Downstream varies from 1V on 2.8H to 1V on 3.6H
- (6) Zoning: Apparently Homogeneous
- (7) Impervious Core: 12 feet wide
- (8) Cutoff: Key Trench to Clay
- (9) Grout Curtain: None

H. Diversion and Regulating Tunnel:

- (1) Type: Not Applicable
- (2) Length: Not Applicable
- (3) Closure: Not Applicable
- (4) Access: Not Applicable
- (5) Regulating Facilities: Not Applicable

I. Spillway:

I.1 Principal Spillway:

- (1) Location: East Abutment
- (2) Type: Earth Cut Swale
- (3) Upstream Channel: Earth Cut Channel
- (4) Downstream Channel: Lightly grass covered to wooded, earth channel with moderate side slopes

I.2 Emergency Spillway:

- (1) Location: None
- (2) Type: Not Applicable

J. Regulating Outlets:

The regulating outlet associated with this dam is the gate valve on the downstream end of the 8 inch diameter pipe through the embankment.

## SECTION 2 - ENGINEERING DATA

### 2.1 DESIGN:

The design of a dam at this location was presumably done by the Soil Conservation Service, but no design calculations or plans were available. The structure as designed by SCS was reported to be a 15 foot high embankment. The dam, as built, is 25 feet high. No documentation of construction inspection records is known to exist. To our knowledge, there are no documented maintenance data.

#### A. Surveys:

No information regarding pre-construction surveys was able to be obtained. A rock ledge at Station 0 + 00 was used as a reference elevation for all field monuments. An elevation of 784.0 mean sea level was estimated for this point using U.S.G.S. quad sheets.

#### B. Geology and Subsurface Materials:

The site is located in the Central portion of the Ozarks geologic region of Missouri. The Ozarks are characterized topographically by hills, plateaus, and deep valleys. The most common bedrock types are dolomite, sandstone, and chert.

Information supplied by the Missouri Geological Survey indicates that the bedrock in the Valley is the Eminence Formation. This formation is composed principally of medium to massively bedded, light gray, medium to coarse grained dolomite. The Missouri Geological Survey reports that the Eminence in the site area is very badly weathered and pinnacled. In addition, much solution work has taken place on both the vertical joints and the horizontal bedding planes. Numerous small springs exist upstream and downstream of the dam. The publication "Caves of Missouri" indicates that there are 10 named caves in Carter County. Of these caves, two are within a 7 mile radius of the site.

The Geologic map of Missouri indicates that a normal fault, northeastly-southwesterly in direction, terminates approximately 5 miles northeast of the site. The Missouri Geological Survey has indicated that the faults in this area are generally considered to be inactive and have been for several hundred million years.

Soils in the area of the dam appear to be primarily Clarksville Stony Loam. The Clarksville series subsoil is a reddish-yellow to red silty clay to heavy, stiff, tenacious, compact clay. These residual soils are derived from cherty and dolomitic limestone. Chert fragments are very common in the Clarksville soils. The loessial thickness map indicates that upland areas have less than 2.5 feet of loess cover.

### C. Foundation and Embankment Design:

No design computations are available. Seepage and stability analyses apparently were not performed as required in the guidelines. There is apparently no particular zoning of the embankment, and no internal drainage features are known to exist.

### D. Hydrology and Hydraulics:

No hydrologic or hydraulic design computations for this dam were available. Based on field measurements of spillway dimensions, embankment elevations, and a check of the drainage area on U.S.G.S. quad sheets, hydrologic analyses using U. S. Army Corps of Engineer guidelines were performed and appear in Appendix C, Sheets 1 through 9.

### E. Structure:

There are no structures associated with this dam.

## 2.2 CONSTRUCTION:

No construction inspection data have been obtained.

## 2.3 OPERATION:

Normal flows are passed by the uncontrolled spillway section located at the east abutment. The lake level can be lowered by use of the drawdown pipe located at the center of the dam. The owner indicated that 24 hours are required to lower the lake 1 foot from the normal pool level.

## 2.4 EVALUATION:

### A. Availability:

No engineering data, seepage or stability analyses, or construction test data were available.

### B. Adequacy:

The engineering data available were inadequate to make a detailed assessment of the design, construction, and operation of this structure. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions and made a matter of record.

### C. Validity:

To our knowledge, no valid engineering data on the design or construction of the embankment are available.

## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS:

#### A. General:

The field inspection was made on July 18, 1980. The inspection team consisted of personnel from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The team members were:

Steven L. Brady, P.E. - Anderson Engineering, Inc. (Civil Engineer)  
Tom Beckley, P.E. - Anderson Engineering, Inc. (Civil Engineer)  
Jack Healy, P.E. - Hanson Engineers, Inc. (Geotechnical Engineer)  
Gene Wertepny, P.E. - Hanson Engineers, Inc. (Hydraulic Engineer)

Photographs of the dam, appurtenant structures, reservoir, and downstream features are presented in Appendix D.

#### B. Dam:

The embankment appears to be in good condition. No sloughing or other unusual movements of the embankment were observed. The horizontal and vertical alignments of the dam were good except for the vertical alignment near Station 2 + 50. An erratic profile was noted in this area. The reported settlement and subsequent filling in of the area was the apparent reason for the inconsistent elevations. The side slopes of the embankment were good. The side slopes were flatter than planned due to the material removed from the crest of the embankment. The slopes of the embankment had very light ground cover. A few scattered trees and brush were noted on the embankment slopes. Minor erosion channels were noted on the downstream face of the dam.

A wet, marshy area was observed at the toe of the embankment surrounding the pipe outlet area. Seepage from the valve, not through the embankment, appeared to be the reason for the marshy area. The two inch flexible hose connected to the outlet valve cover plate was used to fill the downstream fish ponds.

The water level of the downstream fish ponds was maintained about 4.5 feet above the lowest toe elevation. Inspection of the embankment toe could not be accomplished due to the water level of the fish ponds.

No apparent seepage was observed through the embankment. No animal burrows were noted.

Shallow auger probes into the embankment indicated that the dam consisted of a yellowish-brown silty clay with chert fragments.

No instrumentation (monuments, piezometers, etc.) was observed.

### C. Appurtenant Structures:

#### C.1 Principal Spillway:

The approach channel to the earth cut spillway was clear. No significant erosion was observed in the spillway channel. No provision for a non-erodible spillway section was noted.

#### C.2 Emergency Spillway:

There is no emergency spillway associated with this dam.

### D. Reservoir:

The watershed is generally wooded with mild to moderate side slopes. No sloughing or erosion of the reservoir slopes was noted. Sedimentation of the reservoir appeared to be minor.

### E. Downstream Channel:

The downstream channel immediately downstream is lightly grass covered to wooded. The side slopes of the channel are moderate. When the flow in the immediate downstream channel exceeds about 1 foot, the flow will spill over the channel and be diverted along the abutment-embankment contact into the fish pond.

### 3.2 EVALUATION:

Trees and brush on the dam constitute a potential seepage hazard and encourage animal burrowing. There is no wave protection provided for the upstream slope. A non-erodible control section is not provided for the spillway; therefore, progressive erosion could lower the elevation of the spillway, and thus lower the normal pool elevation of the reservoir. The seepage from the drawdown pipe valve could affect the stability of the embankment if unchecked, or could result in continued lowering of the lake level.

## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES:

The gate valve on the drawdown pipe is used to lower the lake level and provide a source of water for the downstream fish ponds. The pool is normally controlled by rainfall, runoff, evaporation, the drawdown pipe, the leakage through the gate valve, and the capacity of the uncontrolled spillway.

### 4.2 MAINTENANCE OF DAM:

The owner indicated that maintenance is on an as needed basis.

### 4.3 MAINTENANCE OF OPERATING FACILITIES:

There has been no maintenance of the operating facilities.

### 4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT:

The inspection team is unaware of any existing warning system for this dam.

### 4.5 EVALUATION:

The trees and brush on the dam, erosion of the slope, lack of riprap, spillway overflow along the abutment-embankment contact, leakage from drawdown valve, and a non-erodible spillway control section are deficiencies which could become serious if corrective action is not taken. Remedial measures should be investigated by an engineer experienced in the design and construction of dams.

## SECTION 5 - HYDRAULIC/HYDROLOGIC

### 5.1 EVALUATION OF FEATURES:

#### A. Design Data:

No hydrologic or hydraulic design computations for this dam were available.

#### B. Experience Data:

No recorded rainfall, runoff, discharge, or reservoir stage data were available for this lake and watershed. The owner stated that four inches of flow above the spillway flow line is the maximum flow he has seen. Our hydrologic and hydraulic analyses using U.S. Army Corps of Engineers guidelines appear in Appendix C.

#### C. Visual Observations:

The approach area to the spillway is clear. The outlet channel varies from clear to wooded. There is no non-erodible spillway control section provided. Spillway releases, under 1 foot in depth, are diverted away from the dam, and these releases would not be expected to endanger the dam. For flows exceeding 1 foot, the flows will spill over the spillway section and flow along the abutment-embankment contact into the downstream fish pond.

#### D. Overtopping Potential:

The hydraulic and hydrologic analyses (using the U. S. Army Corps of Engineers guidelines and the HEC-1 computer program) were based on: (1) a field survey of spillway dimensions and embankment elevations; and (2) an estimate of the reservoir storage and the pool and drainage areas from the Hunter, Missouri 7.5 minute U.S.G.S quad sheet.

Based on the hydrologic and hydraulic analyses presented in Appendix C, the spillway will pass 37 percent of the Probable Maximum Flood. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The recommended guidelines from the Department of the Army, Office of the Chief of Engineers, require that this structure (small size with high downstream hazard potential) pass 50 percent to 100 percent of the PMF, without overtopping. Considering the height of dam (25 feet) and the maximum storage capacity (63 acre-feet), 50 percent of the PMF has been determined to be the appropriate spillway design flood. The spillway will pass a 1 percent probability flood without overtopping the dam.



Application of the probable maximum precipitation (PMP), minus losses, resulted in a flood hydrograph peak inflow of 1,476 cfs. For 50 percent of the PMF, the peak inflow was 738 cfs.

The routing of the PMF through the spillway and dam indicates that the dam will be overtopped by 1.0 ft at elevation 785.0. The duration of the overtopping will be 1.75 hours, and the maximum outflow will be 1,219 cfs. The maximum discharge capacity of the spillway is 230 cfs. The routing of 50 percent of the PMF indicates that the dam will be overtopped by 0.4 ft at elevation 784.4. The maximum outflow will be 387 cfs, and the duration of overtopping will be 0.5 hours. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure.

## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY:

#### A. Visual Observations:

Observed features which could adversely affect the structural stability of this dam are discussed in Sections 3.1B and 3.2.

#### B. Design and Construction Data:

Seepage and stability analyses comparable to the requirements of the guidelines were not available, which constitutes a deficiency which should be rectified.

#### C. Operating Records:

No operating records have been obtained.

#### D. Post-Construction Changes:

The post-construction changes included the construction of the downstream fish hatchery ponds.

#### E. Seismic Stability:

The structure is located in seismic zone 2. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size.

## SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

### 7.1 DAM ASSESSMENT:

This Phase I inspection and evaluation should not be considered as being comprehensive since the scope of work contracted for is far less detailed than would be required for an in-depth evaluation of dams. Latent deficiencies, which might be detected by a totally comprehensive investigation, could exist.

#### A. Safety:

The embankment is generally in good condition. Several items were noted during the visual inspection which should be investigated further, corrected or controlled. These items are: (1) small trees and brush on the embankment; (2) erosion on the downstream slope; (3) lack of wave protection; (4) seepage through the downstream slope; (5) non-erodible spillway control section; and (6) lack of adequate spillway-embankment separations.

Another deficiency was the lack of seepage and stability analyses records.

The dam will be overtopped by flows in excess of 37 percent of the Probable Maximum Flood. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure.

#### B. Adequacy of Information:

The conclusions in this report were based on the performance history as related by others, and visual observation of external conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

#### C. Urgency:

The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. If the deficiencies listed in paragraph A are not corrected, and if good maintenance is not provided, the embankment condition will continue to deteriorate and possibly could become serious in the future. The items recommended in paragraph 7.2A should be pursued without undue delay.

#### D. Necessity for Additional Inspection:

Based on the results of the Phase I inspection, no additional inspection is recommended.

#### E. Seismic Stability:

The structure is located in seismic zone 2. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size.

#### 7.2 REMEDIAL MEASURES:

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams.

##### A. Alternatives:

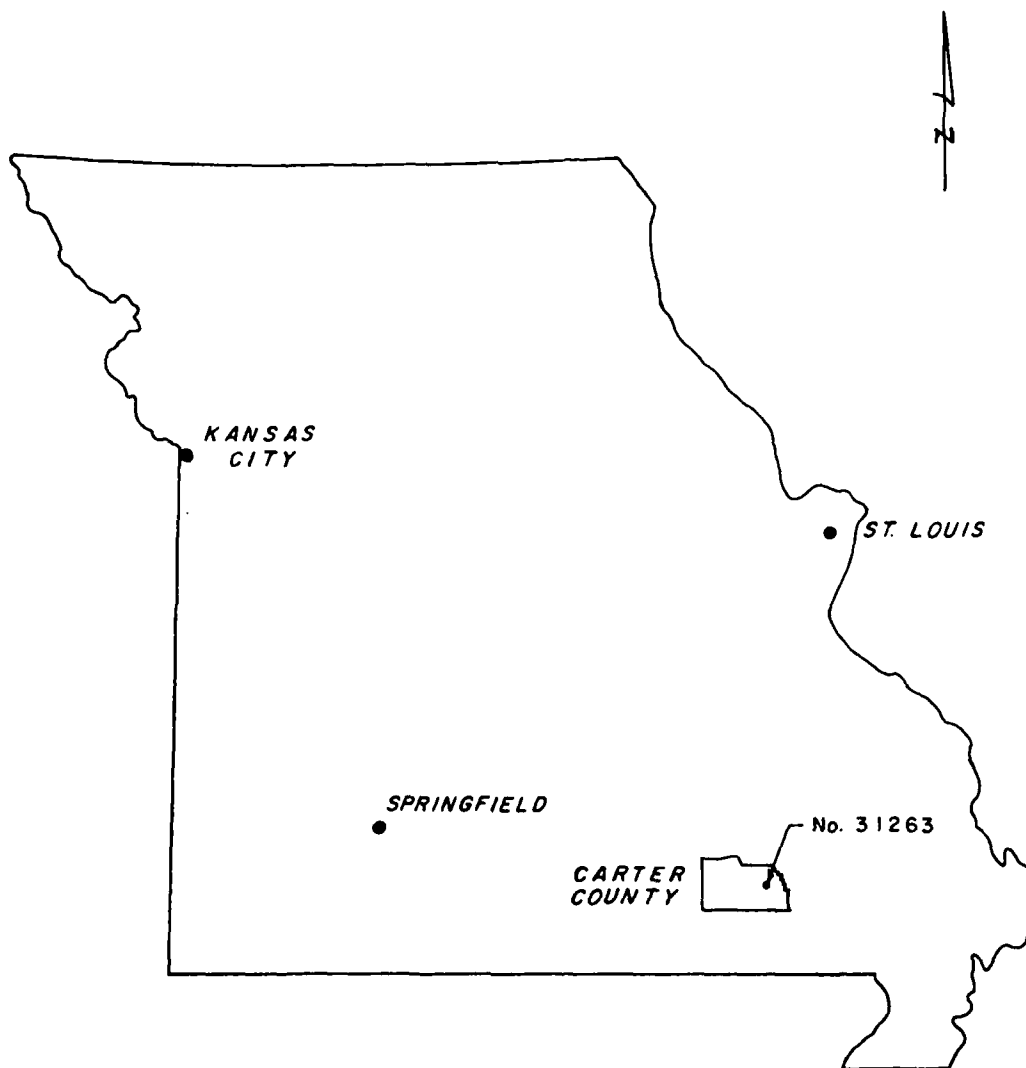
- (1) Spillway size and/or height of dam should be increased to pass 50 percent of the PMF. In either case, the spillway should be protected to prevent erosion.

##### B. O & M Procedures:

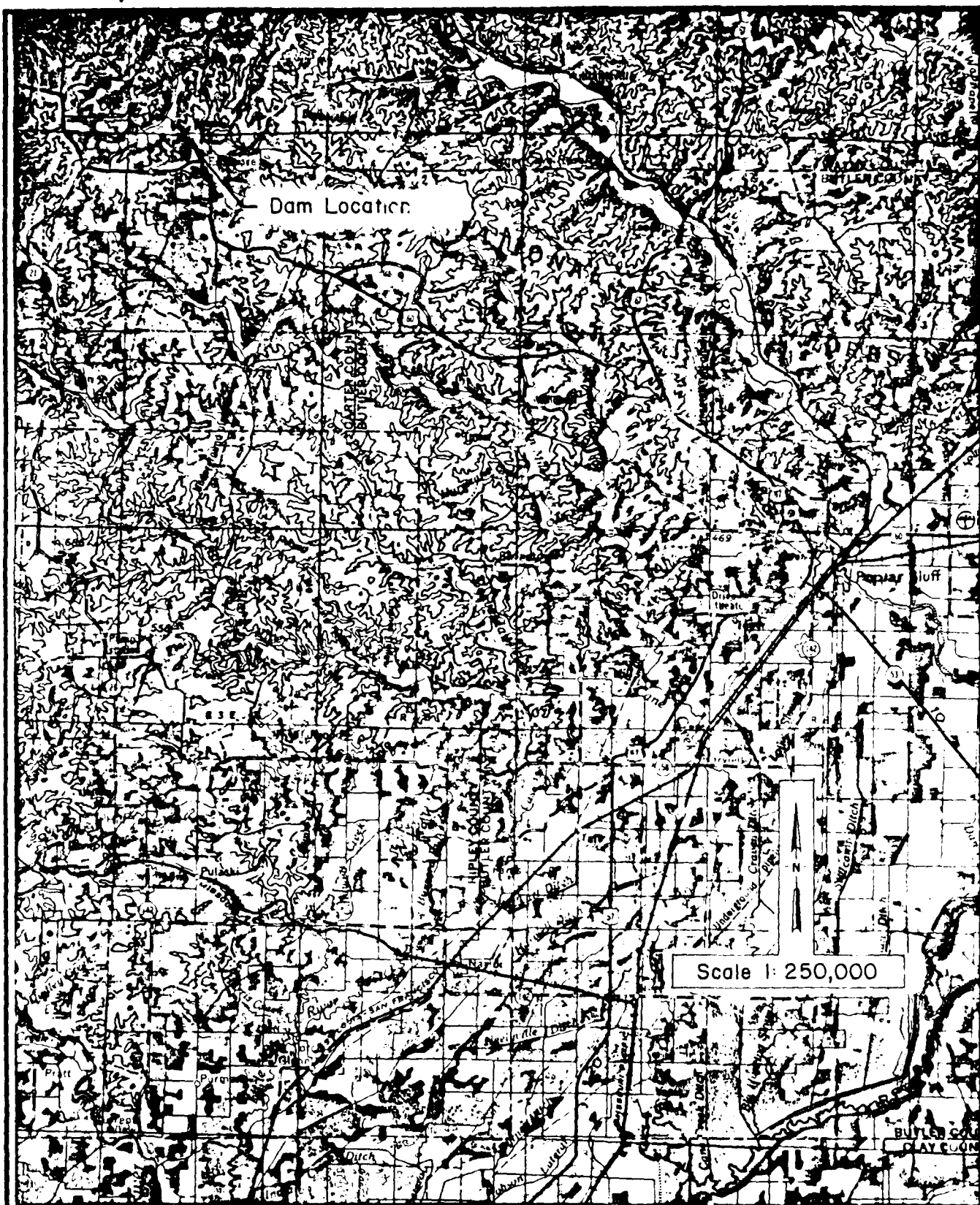
- (1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the construction of dams.
- (2) Brush and tree growth should be removed from the dam. This should be done under the guidance of a professional engineer experienced in the design and construction of dams. Indiscriminate clearing methods could jeopardize the safety of the dam.
- (3) The eroded areas should be repaired and maintained.
- (4) Wave protection should be provided for the upstream face of the dam.
- (5) The gate valve should be repaired to prevent leakage.
- (6) A non-erodible spillway control section should be provided.
- (7) The embankment-abutment contact should be protected from excess spillway flows.
- (8) A detailed inspection of the dam should be made periodically by an engineer experienced in the design and construction of dams.

# **APPENDIX A**

## **Dam Location and Plans**



LOCATION MAP



VICINITY MAP

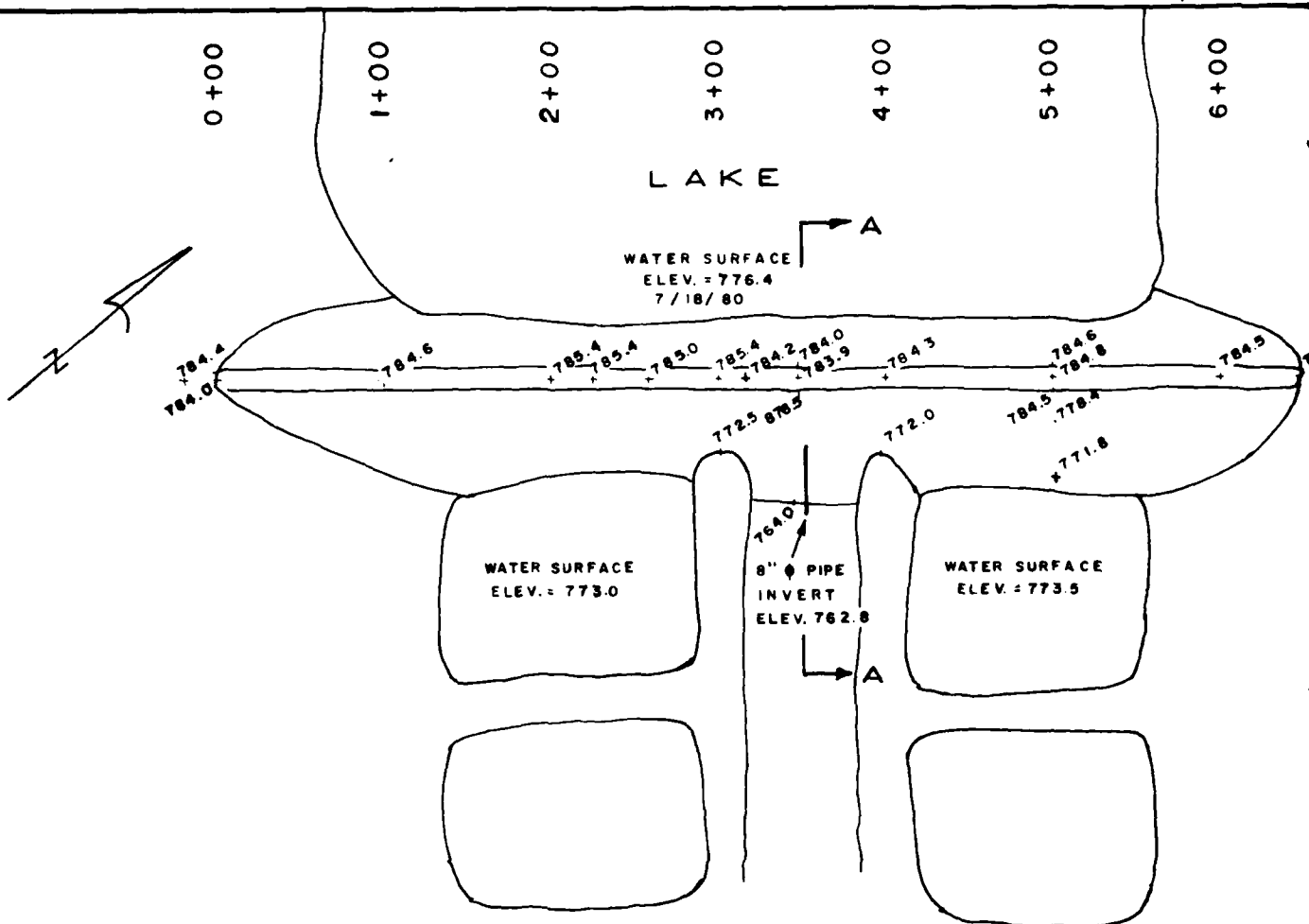


HANSON  
ENGINEERS  
INCORPORATED

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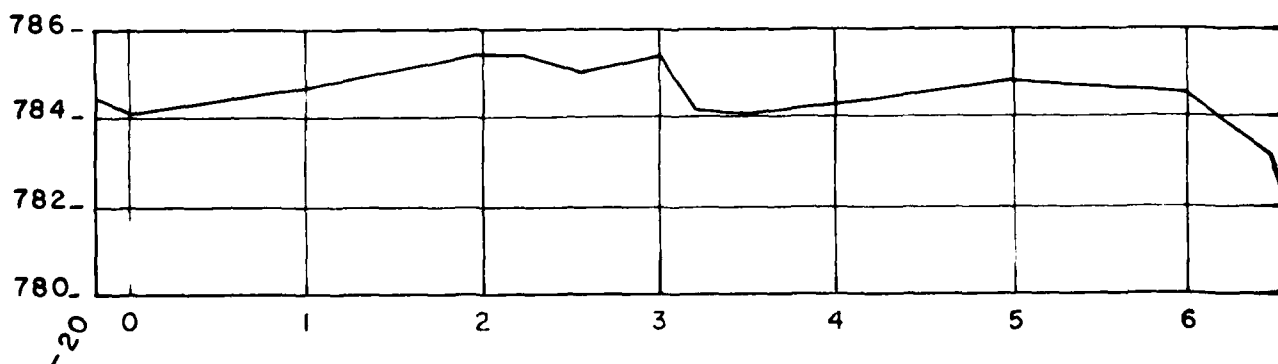
Wallace Lake Dam  
Carter County, Missouri  
Mo. I.D. No. 31263

Sheet 2, Appendix A



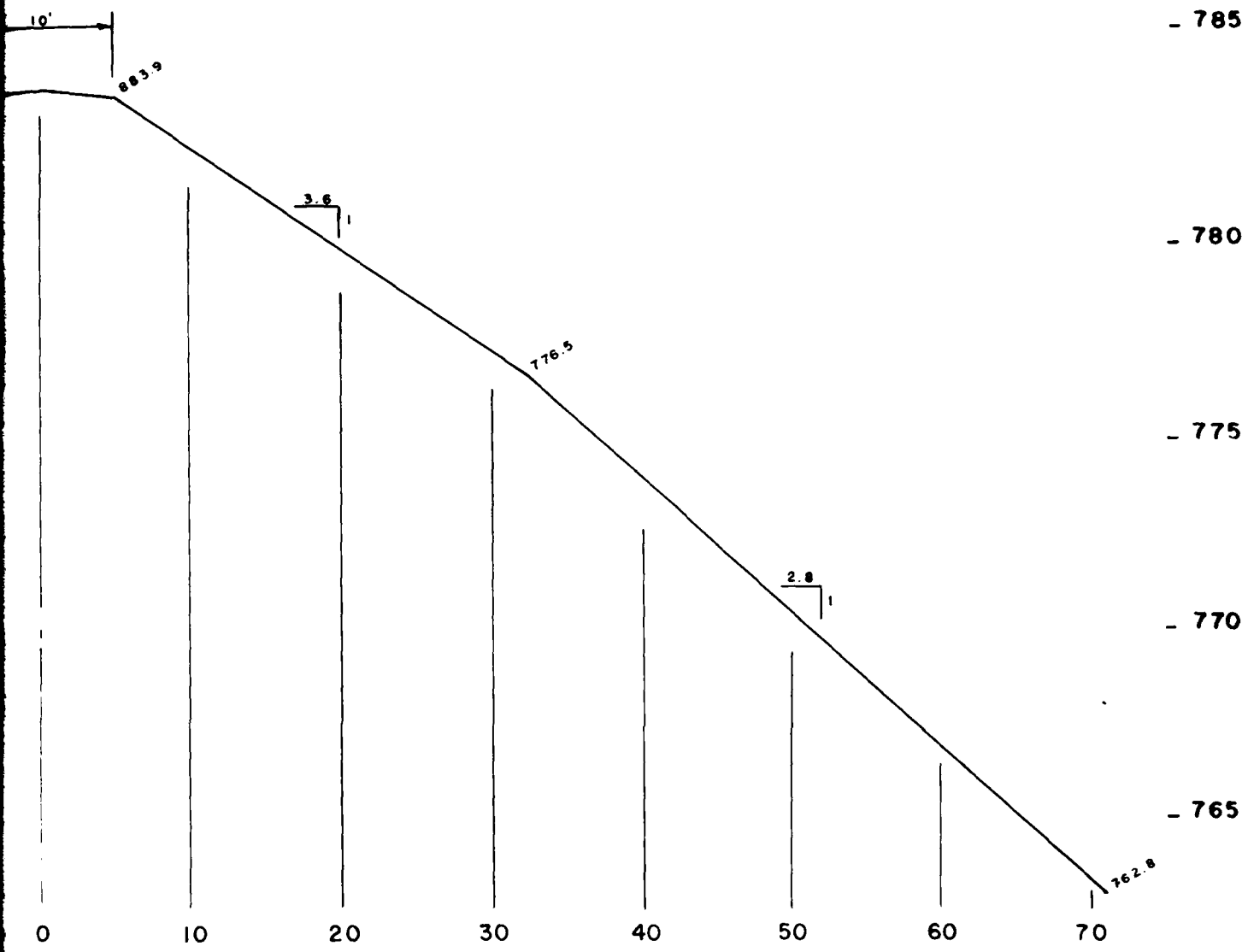
BENCHMARK:  
ROCK AT STA 0+00  
CENTER OF DAM  
ELEV. 784.0

PLAN VIEW  
SCALE: 1" = 100'









ON A - A STA 3+50

SHEET 3 APPENDIX A

ANDERSON ENGINEERING, INC.  
730 NORTH BENTON AVENUE  
SPRINGFIELD, MISSOURI 65802

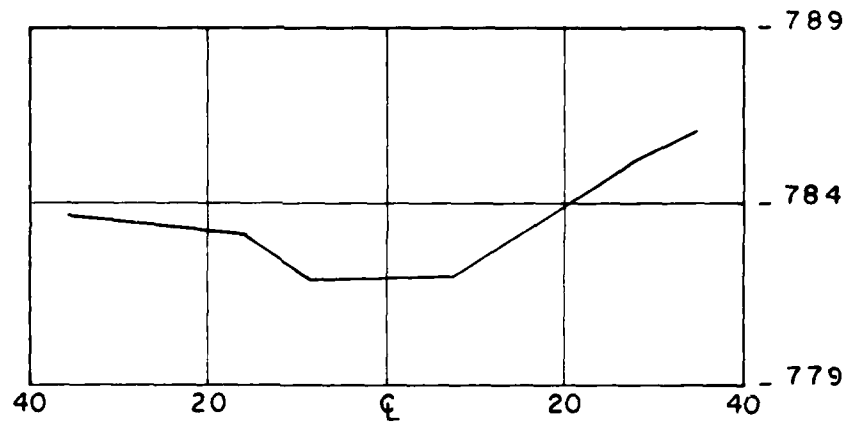
WALLACE LAKE DAM

MO. No. 31263

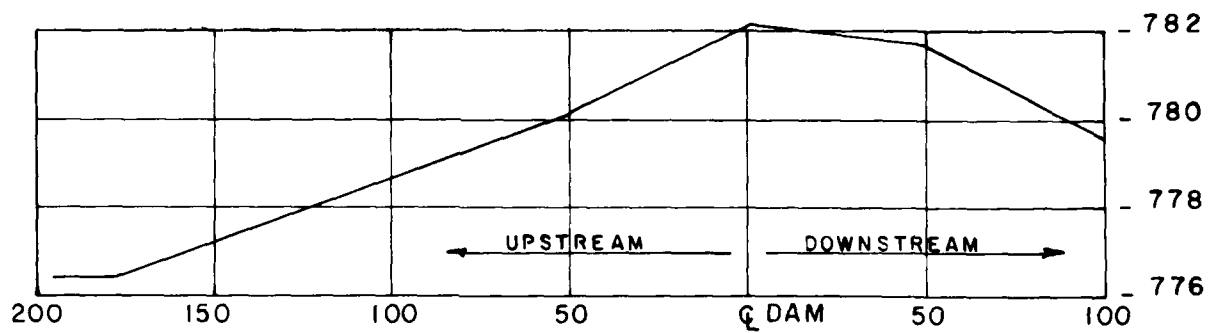
PLAN & PROFILE

CARTER COUNTY, MO.

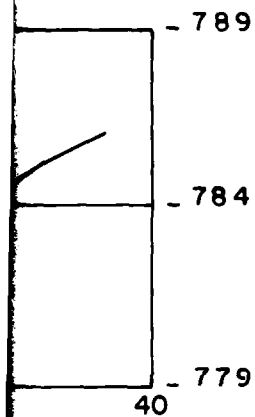
0.2



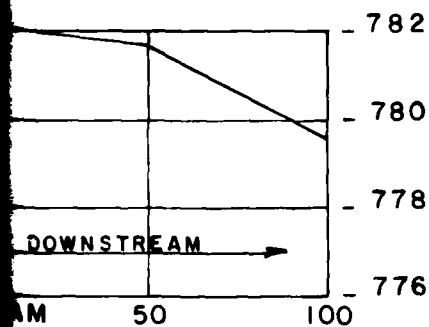
SPILLWAY SECTION  $\phi$  DAM



SPILLWAY PROFILE



DAM



SHEET 3A APPENDIX A

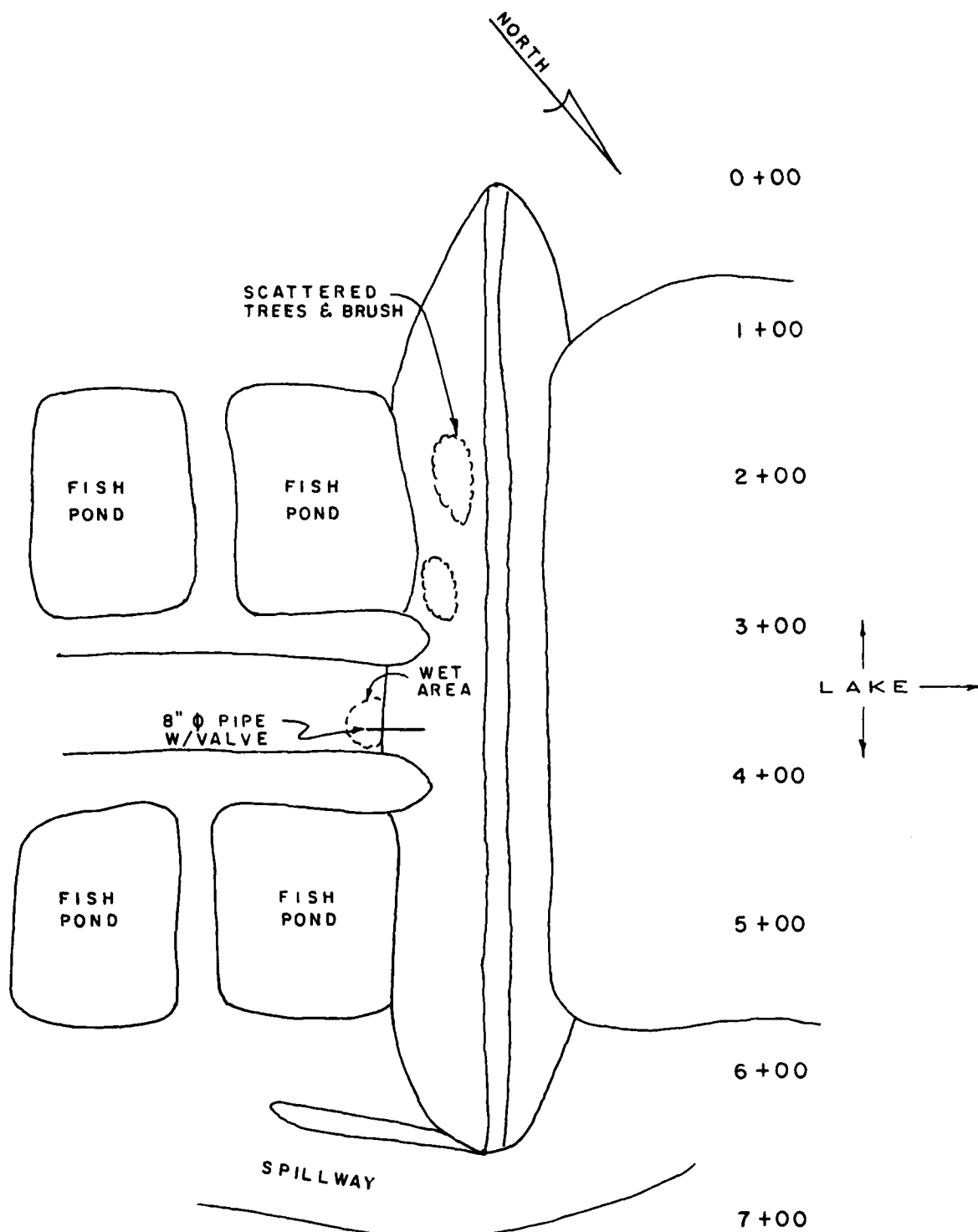
ANDERSON ENGINEERING, INC.  
730 NORTH BENTON AVENUE  
SPRINGFIELD, MISSOURI 65802

WALLACE LAKE DAM

MO. No. 31263

SPILLWAY  
SECTION & PROFILE

CARTER COUNTY, MO.



PLAN SKETCH OF DAM  
WALLACE LAKE DAM  
MO. No. 31263

## **APPENDIX B**

### **Geology and Soils**




LEGEND

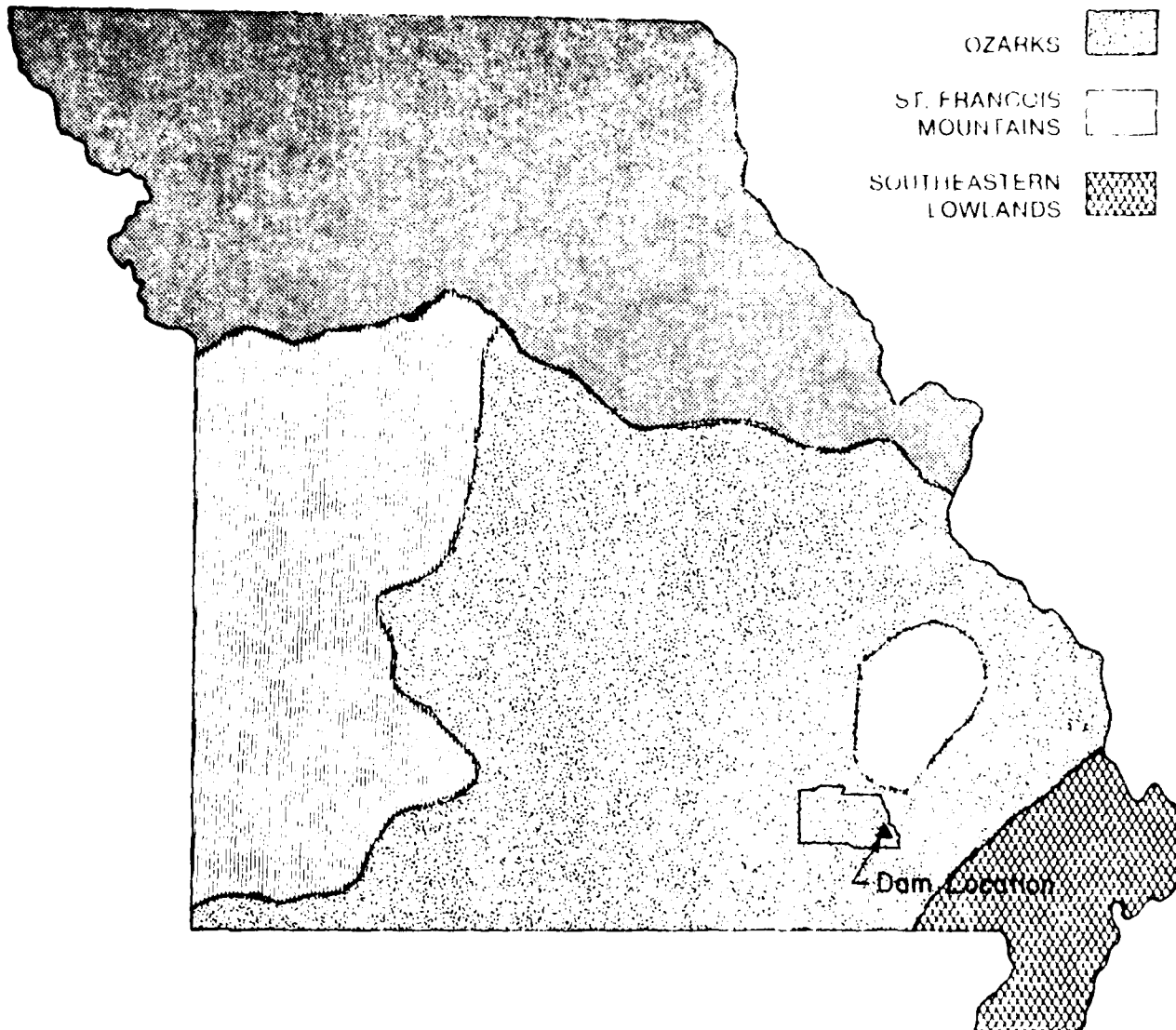
GLACIATED PLAINS 

WESTERN PLAINS 

OZARKS 

ST. FRANCIS MOUNTAINS 

SOUTHEASTERN LOWLANDS 



MAJOR GEOLOGIC REGIONS OF MISSOURI

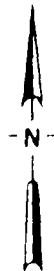


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Carter County, Missouri  
Mo. I.D. No. 31263

SHEET 1, APPENDIX B



FEET

20 +



10-20



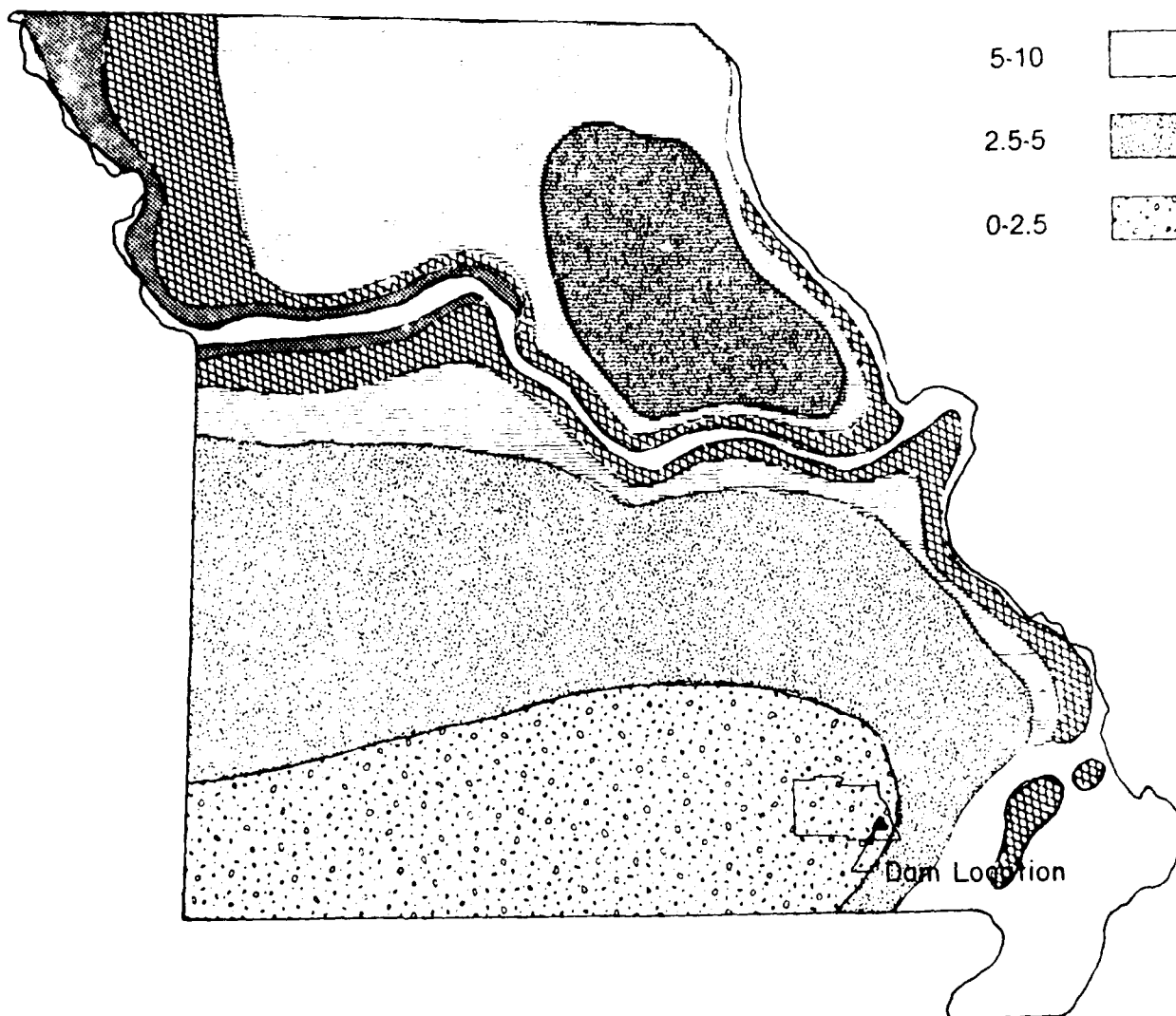
5-10



2.5-5



0-2.5



THICKNESS OF LOESSIAL DEPOSITS



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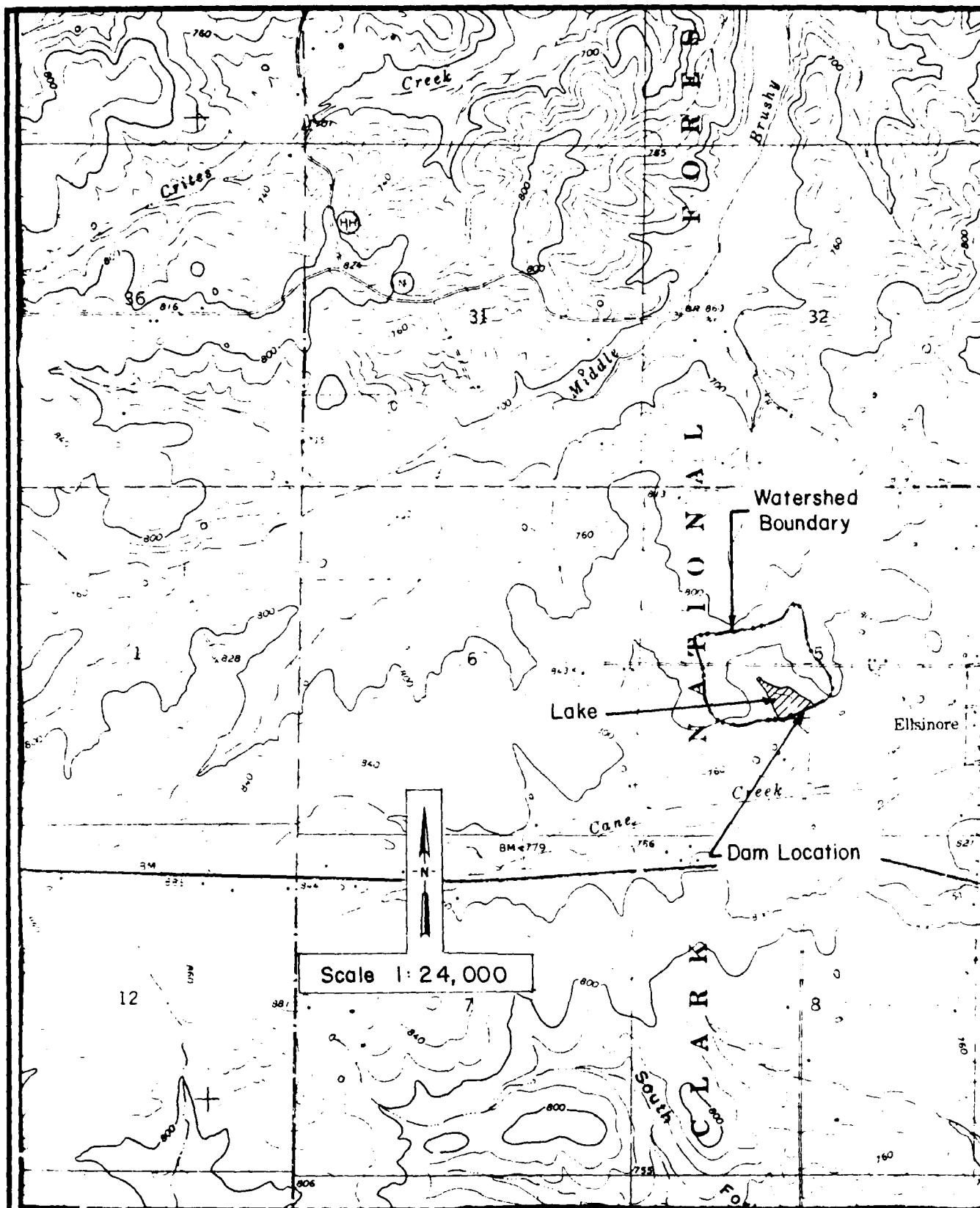
Wallace Lake Dam  
Carter County, Missouri  
Mo. I.D. No. 31263

SHEET 2, APPENDIX B



# **APPENDIX C**

## **Overtopping Analysis**



# LAKE AND WATERSHED MAP



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Wallace Lake Dam  
Carter County, Missouri  
Mo. I.D. No. 31263

Sheet I, Appendix C

## APPENDIX C

### HYDROLOGIC AND HYDRAULIC ANALYSIS

To determine the overtopping potential, flood routings were performed by applying the Probable Maximum Precipitation (PMP) to a synthetic unit hydrograph to develop the inflow hydrograph. The inflow hydrograph was then routed through the reservoir and spillway. The overtopping analysis was accomplished using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California.

The PMP was determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33." Reduction factors were not applied. The rainfall distribution for the 24-hour PMP storm duration was assumed according to the procedures outlined in EM 1110-2-1411 (SPD Determination). Also, the 1 percent chance probability flood was routed through the reservoir and spillway. Doniphan rainfall distribution (5 min. interval - 24 hours duration), as provided by the St. Louis District, Corps of Engineers, was used in this case.

The synthetic unit hydrograph for the watershed was developed by the computer program using the SCS method. The parameters for the unit hydrograph are shown in Table 1 (Sheet 3, Appendix C).

The SCS curve number (CN) method was used in computing the infiltration losses for rainfall-runoff relationship. The CN values used, and the result from the computer output, are shown in Table 2 (Sheet 4, Appendix C).

The reservoir routing was accomplished by using the Modified Puls Method. The hydraulic capacity of the spillway was used as an outlet control in the routing. The hydraulic capacity of the spillway and the storage capacity of the reservoir were defined by the elevation-surface area--storage-discharge relationships shown in Table 3 (Sheet 4, Appendix C.)

The rating curve for the spillway (see Table 4, Sheet 5, Appendix C) was determined assuming critical flow conditions at the control section.

The flow over the crest of the dam during overtopping was determined using the non-level dam option (\$L and \$V cards) of the HEC-1 program. The program assumes critical flow over a broad-crested weir.

A summary of the routing analysis for different ratios of the PMF is shown in Table 5 (Sheet 6, Appendix C).

The result of the routings of the PMF ratios indicate that the dam and spillway will hold and pass the 1 percent probability flood without overtopping the dam.

The computer input data, a summary of the output data, and a plot of the inflow-outflow hydrograph for the PMF are presented on Sheets 7, 8, and 9 of Appendix C.

TABLE 1  
SYNTHETIC UNIT HYDROGRAPH

Parameters:

Drainage Area (A)	0.088 sq miles
Length of Watercourse (L)	0.25 miles
Difference in elevation (H)	58 ft
Time of concentration (Tc)	0.11 hrs
Lag Time (Lg)	0.07 hrs
Time to peak (Tp)	0.11 hrs
Peak Discharge (Qp)	390 cfs
Duration (D)	5 min.

<u>Time (Min.)(*)</u>	<u>Discharge (cfs)(*)</u>
0	0
5	324
10	255
15	73
20	21
25	6
30	2
35	0

(\*) From the computer output

FORMULA USED:

$$T_c = \left( \frac{11.9 L^3}{H} \right)^{0.385} \quad \text{From California Culverts Practice, California Highways and Public Works, September, 1942.}$$

$$L_g = 0.6 T_c$$

$$T_p = \frac{D}{2} + L_g$$

$$Q_p = \frac{484 A \cdot Q}{T_p} \quad Q = \text{Excess Runoff} = 1 \text{ inch}$$

TABLE 2  
RAINFALL-RUNOFF VALUES

<u>Selected Storm Event</u>	<u>Storm Duration (Hours)</u>	<u>Rainfall (Inches)</u>	<u>Runoff (Inches)</u>	<u>Loss (Inches)</u>
PMP	24	35.62	32.86	2.76

Additional Data:

- 1) Soil Conservation Service Soil Group B
- 2) Soil Conservation Service Runoff Curve CN = 78 (AMC III) for the PMF
- 3) Soil Conservation Service Runoff Curve CN = 60 (AMC II) for the  
1 percent chance flood
- 4) Percentage of Drainage Basin Impervious 13 percent

TABLE 3  
ELEVATION, SURFACE AREA, STORAGE AND DISCHARGE RELATIONSHIPS

<u>Elevation (ft, MSL)</u>	<u>Lake Surface Area (acres)</u>	<u>Lake Storage (acre-ft)</u>	<u>Spillway Discharge (cfs)</u>
762.0	0	0	-
780.0	4.6	35	-
*782.0	7.0	47	0
**784.0	9.0	63	230
786.0	11.0	83	1,200
790.0	14.0	133	-
800.0	24.0	-	-

\*Principal spillway crest elevation

\*\*Top of dam elevation

The above relationships were developed using data from the USGS Hunter, MO  
7.5 minute quadrangle map and the field measurements.

TABLE 4

SPILLWAY RATING CURVE

<u>Reservoir Elevation (MSL)</u>	<u>Principal Spillway (cfs)</u>
782.0	0
783.0	60
783.4	125
*784.0	230
784.5	390
785.0	600
785.5	860
786.0	1,200
787.3	2,300

\*Top of dam elevation

METHOD USED: Assuming critical flow condition at the control section

FORMULA:  $\frac{Q^2}{g} = \frac{A^3}{T}$

Q = Discharge in cubic feet per second  
A = Cross sectional area in square feet  
T = Water surface width in feet  
g = Acceleration of gravity in ft/sec<sup>2</sup>

TABLE 5  
RESULTS OF FLOOD ROUTINGS

Ratio of PMF	Peak Inflow (cfs)	Peak Lake Elevation (ft, MSL)	Total Storage (acre-ft)	Peak Outflow (cfs)	Depth (ft.) Over Top of Dam
-	0	*782.0	47	0	-
0.10	148	782.6	52	38	-
0.15	221	783.0	55	57	-
0.20	295	783.2	57	90	-
0.25	369	783.5	59	124	-
0.30	443	783.7	61	173	-
0.37	546	**784.0	63	230	0
0.40	590	784.1	64	263	0.1
0.50	738	784.4	67	387	0.4
0.75	1,107	784.7	70	763	0.7
1.00	1,476	785.0	73	1,219	1.0

The percentage of the PMF that will reach the top of the dam is 37 percent.

\*Principal spillway crest elevation

\*\*Top of dam elevation

A OVERTOPPING ANALYSIS FOR WALLACE LAKE DAM ( # 22 )  
 A STATE ID NO. 31263 COUNTY NAME : CARTER  
 A HANSON ENGINEERS INC. DAM SAFETY INSPECTION JOB # 80S3001  
 B 300 5  
 B1 5  
 J 1 9 1  
 J1 .10 .15 .20 .25 .30 .40 .50 .75 1.0  
 K 0 1 3 1  
 K1 INFLOW HYDROGRAPH COMPUTATION \*\*  
 M 1 2 0.088 0.088 1  
 P 0 27.4 102 120 130  
 T  
 M2 0.11 0.07  
 X 0 -.1 2  
 K 1 2  
 K1 RESERVOIR ROUTING BY MODIFIED PULS AT DAM SITE \*\*  
 Y 1 1  
 Y1 1  
 Y4 782.0 783.0 783.5 784.0 784.5 785.0 785.5 786.0 787.3  
 Y5 0 60 125 230 390 600 860 1200 2300  
 \$5 0 35 47 83 133  
 \$E 762.0 780.0 782.0 784.0 786.0 790.0  
 \$\$ 782.0  
 \$B 784.0  
 \$L 0 100 190 310 450 490 640 670  
 \$V 784.0 784.2 784.4 784.6 784.8 785.0 785.4 786.0  
 K 99

PMF RATIOS  
 INPUT DATA



\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS  
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)  
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9
				0.10	0.15	0.20	0.25	0.30	0.40	0.50	0.75	1.00
HYDROGRAPH AT	1	0.09	1	148.	221.	295.	369.	443.	590.	738.	1107.	1476.
	(	0.23)	(	4.18)	6.27)	8.36)	10.45)	12.54)	16.71)	20.89)	31.34)	41.78)
ROUTED TO	2	0.09	1	38.	57.	90.	124.	173.	263.	387.	763.	1219.
	(	0.23)	(	1.07)	1.61)	2.54)	3.51)	4.89)	7.44)	10.96)	21.61)	34.52)

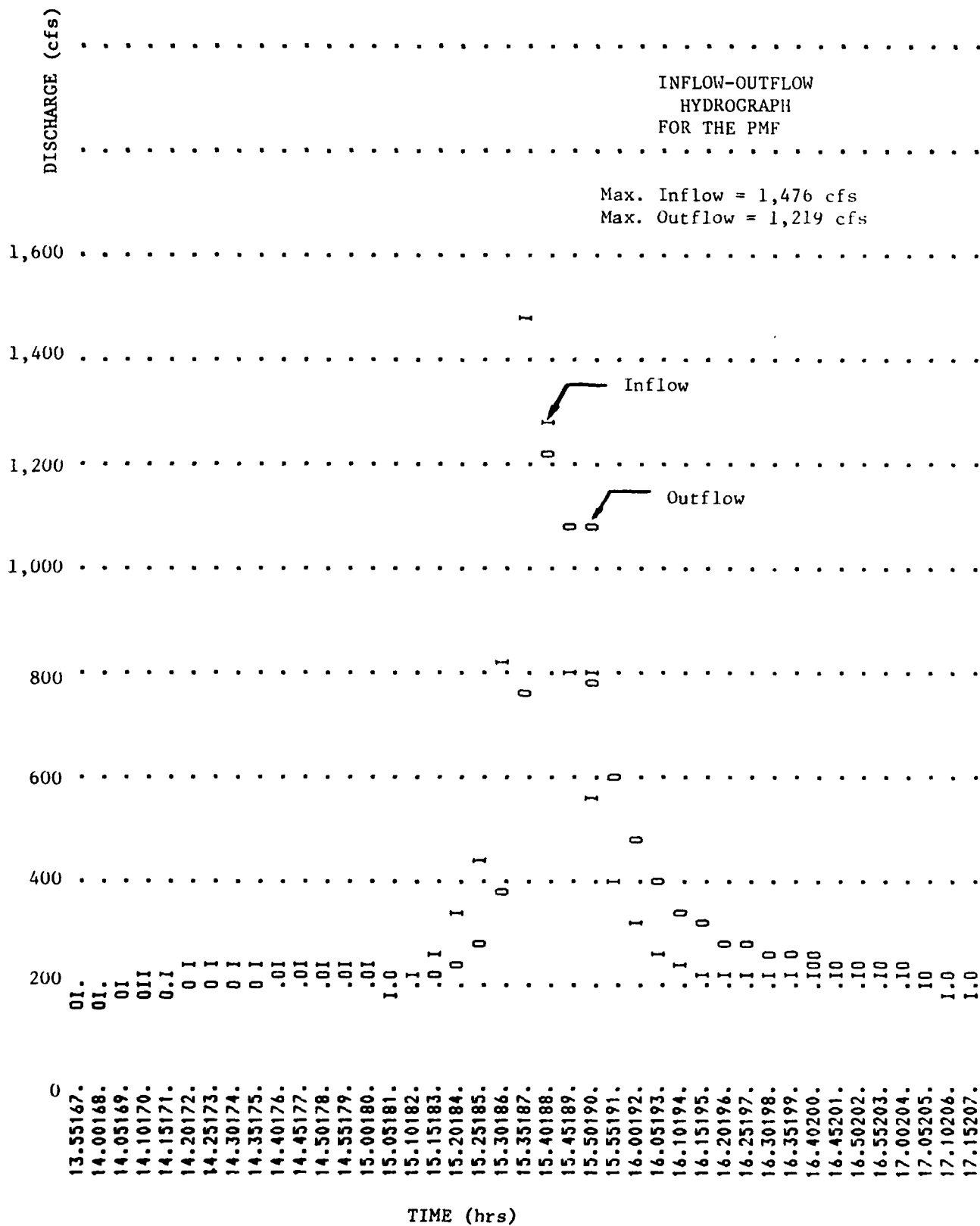
SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	782.00	782.00	784.00
	47.	47.	63.
	0.	0.	230.

ELEVATION  
STORAGE  
OUTFLOW

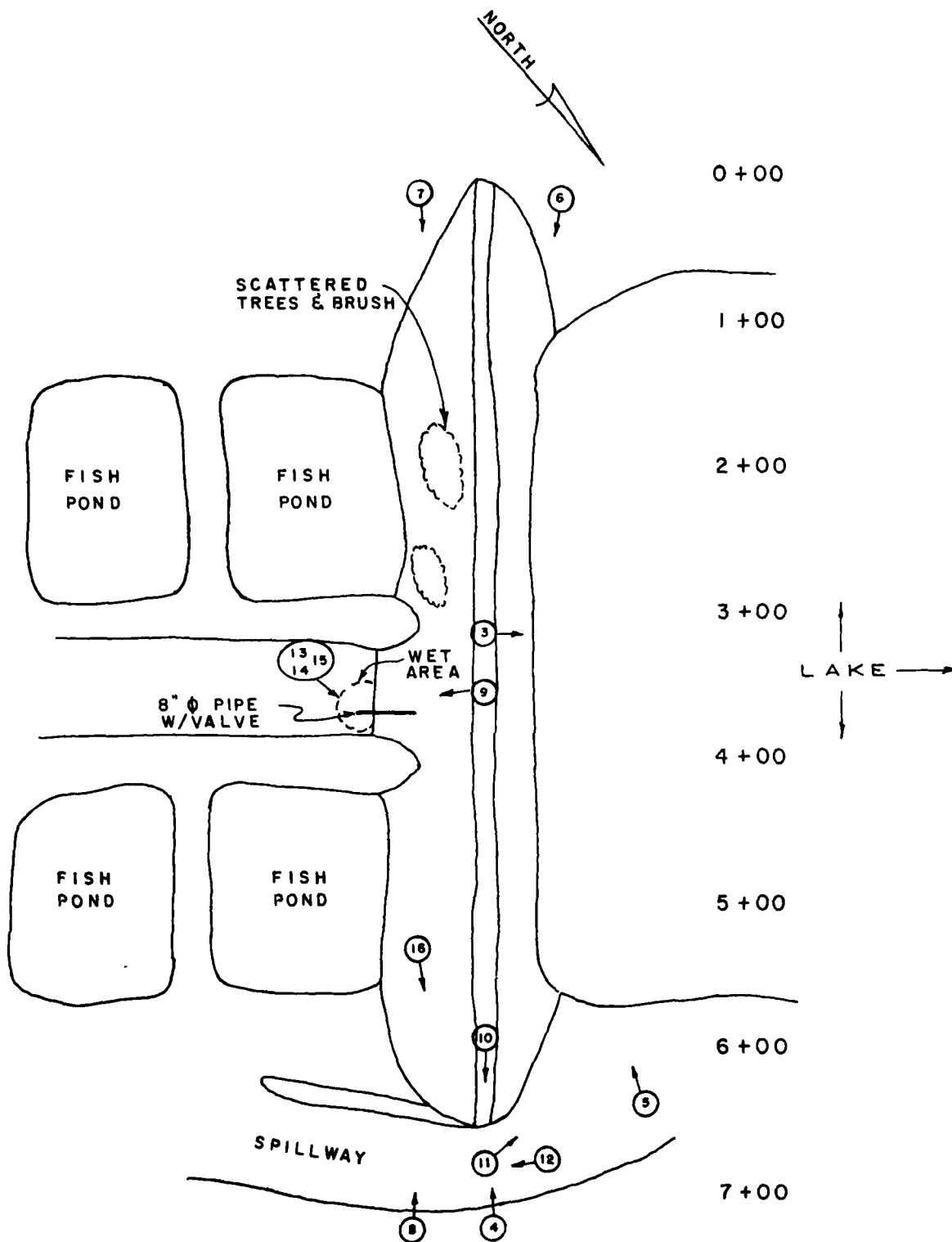
RATIO OF PMF	MAXIMUM RESERVOIR U.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.10	782.63	0.00	52.	38.	0.00	15.92	0.00
0.15	782.95	0.00	55.	57.	0.00	15.92	0.00
0.20	783.23	0.00	57.	90.	0.00	15.92	0.00
0.25	783.49	0.00	59.	124.	0.00	15.83	0.00
0.30	783.73	0.00	61.	173.	0.00	15.83	0.00
0.40	784.10	0.10	64.	263.	0.25	15.83	0.00
0.50	784.35	0.35	67.	387.	0.50	15.75	0.00
0.75	784.73	0.73	70.	763.	0.92	15.75	0.00
1.00	784.99	0.99	73.	1219.	1.75	15.67	0.00

PMF RATIO  
OUTPUT DATA



# **APPENDIX D**

## **Photographs**



PHOTOGRAPH INDEX  
 WALLACE LAKE DAM  
 MO. No. 31263

PHOTOGRAPH INDEX

<u>PHOTO NO.</u>	<u>DESCRIPTION</u>
1	Aerial View of Lake and Dam
2	Aerial View of Lake and Dam
3	View of Reservoir and Watershed
4	Crest of Embankment (Looking West)
5	Upstream Face of Dam (Looking Southwest)
6	Upstream Face of Dam (Looking East)
7	Downstream Face of Dam (Looking East)
8	Downstream Face of Dam (Looking West)
9	View Downstream from Crest of Dam (Looking South)
10	Spillway Channel (Looking East)
11	Spillway Channel Inlet (Looking Northwest)
12	Spillway Channel Outlet (Looking South)
13	Gate Valve at Toe of Dam (Looking North)
14	Downstream From Gate Valve (Looking South)
15	Closeup of Gate Valve
16	Downstream Face of Dam (Looking East)



